

Internal Note No
C7-FM-2



NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

MSC INTERNAL NOTE NO. 69-FM-2

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~~Revised DGE~~

January 7, 1969

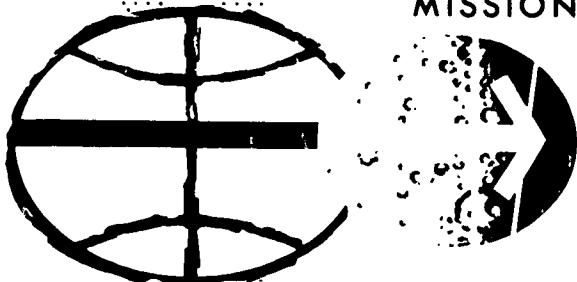
To: *Torrey Pines Scientific, Inc.*

PREDICTED HORIZONTAL VELOCITY
FOR SPACECRAFT LAND LANDINGS
CALCULATED DURING THE APOLLO 8
COUNTDOWN DEMONSTRATION TEST

Flight Analysis Branch

MISSION PLANNING AND ANALYSIS DIVISION

MANNED SPACECRAFT CENTER
HOUSTON, TEXAS



(NASA-TM-X-70021) PREDICTED HORIZONTAL
VELOCITY FOR SPACECRAFT LAND LANDINGS
CALCULATED DURING THE APOLLO 8 COUNTDOWN
DEMONSTRATION TEST (NASA) 26 p

N74-72494

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16864

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PROJECT APOLLO

PREDICTED HORIZONTAL VELOCITY FOR SPACECRAFT
LAND LANDINGS CALCULATED DURING THE APOLLO 8
COUNTDOWN DEMONSTRATION TEST

By Samuel R. Newman and Dallas G. Ives
Flight Analysis Branch

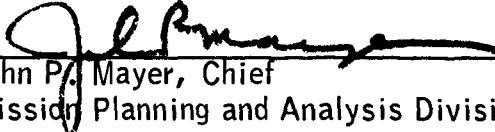
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MISSION PLANNING AND ANALYSIS DIVISION
NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
MANNED SPACECRAFT CENTER
HOUSTON, TEXAS

Approved:


Charlie C. Allen
Charlie C. Allen, Acting Chief
Flight Analysis Branch

Approved:


John P. Mayer, Chief
Mission Planning and Analysis Division

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PREDICTED HORIZONTAL VELOCITY FOR SPACECRAFT LAND LANDINGS
CALCULATED DURING THE APOLLO 8 COUNTDOWN DEMONSTRATION TEST

By Samuel R. Newman and Dallas G. Ives

SUMMARY

This document presents tables and figures which show the peak velocities and predicted horizontal velocities for spacecraft landings calculated during the Apollo 8 countdown demonstration test.

INTRODUCTION

The present design capability of the Apollo spacecraft indicates that in the event of a mode I launch escape vehicle (LEV) abort, a land landing is acceptable provided that the spacecraft's horizontal velocity at landing does not exceed 54 fps (ref. 1).

A procedure has been established which can be used during the prelaunch countdown to provide real-time data concerning the spacecraft's anticipated horizontal landing velocity (ref. 2). This procedure was used during the Apollo 8 countdown demonstration test (CDDT) on December 9, 1968, through December 11, 1968.

METHOD FOR DETERMINING THE HORIZONTAL VELOCITY

The horizontal spacecraft landing velocity is dependent on the peak wind velocity at approximately 162-ft altitude and the peak wind profile from 162 to 500 ft, which describes the rate of change of wind velocity with altitude. The effect of these parameters has been determined in the formulation of the procedure to calculate the horizontal spacecraft landing velocity. A description of this procedure is presented in reference 1.

Briefly the procedure is as follows:

1. The NASA Meteorological Tower (703) at Kennedy Space Center, will be considered the prime source of peak wind data. Backup instrumentation from tower 702 and the top of the launch umbilical tower (L.U.T.) will be used as necessary (ref. 3).

The peak wind velocities in knots are recorded from the 500-ft tower (703) for altitudes of 162, 200, 300, 400, and 500 ft and plotted against the corresponding altitudes on full logarithmic (log-log) paper (fig. 1).

2. Determine a value for the wind profile slope (P) by use of an overlay (fig. 2) which is a family of peak wind profile slopes referenced to the 162-ft altitude.

3. Determine the spacecraft's horizontal landing velocity by use of a plot (fig. 3) which represents lines of constant spacecraft horizontal velocities plotted as functions of P versus peak velocity at 162 ft.

WIND PROFILE MEASUREMENT

The wind profile measurements prior to lift-off (T hours) were recorded at T-minus-5-hours, T-minus-3.5-hours, T-minus-2.5-hours, T-minus-1-hour, and T-minus-0.5-hours in support of the CDDT. For each of these times, the parameters measured were altitude and peak wind velocity.

These data were plotted and are presented in figure 4 (December 9), figure 5 (December 10), and figure 6 (December 11). The peak wind velocity for each time prior to lift-off for each day of the CDDT, and the corresponding value of P and predicted horizontal landing velocity are presented in table I.

CONCLUSIONS

This document presents the predicted horizontal velocities for spacecraft landings calculated in support of the Apollo 8 CDDT.

These data were available to the MSC Flight Director, and KSC Launch Director to aid them in their launch GO - NO-GO criteria.

All of the predicted horizontal velocities were below the spacecraft landing restriction of 54 fps and therefore would not have prevented a successful lift-off.

TABLE I.- APOLLO 8 CDDT WIND DATA

Time prior to lift-off, hr	Peak velocity, knots					Wind profile slope, P	Predicted horizontal landing velocity, fps
	162-ft altitude	200-ft altitude	300-ft altitude	400-ft altitude	500-ft altitude		
(a) December 9, 1968							
T - 5	20	21	20	20	21	0	34
T - 3.5	21	22	21	21	20	0	36
T - 2.5	25	26	27	24	24	0	43
T - 1	24	24	27	24	23	0	41
T - 0.5	24	25	26	26	24	0	42
(b) December 10, 1968							
T - 5	15	14	17	16	16	.05	26
T - 3.5	18	19	21	19	19	.04	32
T - 2.5	19	19	20	19	18	0	32
T - 1	19	18	20	18	19	0	32
T - 0.5	18	19	19	19	19	0	32
(c) December 11, 1968							
T - 5	26	26	29	27	27	.05	46
T - 3.5	25	26	29	27	28	.10	46
T - 2.5	27	27	27	27	26	0	46
T - 1	26	27	29	26	27	0	46
T - 0.5	25	26	29	29	26	0	46

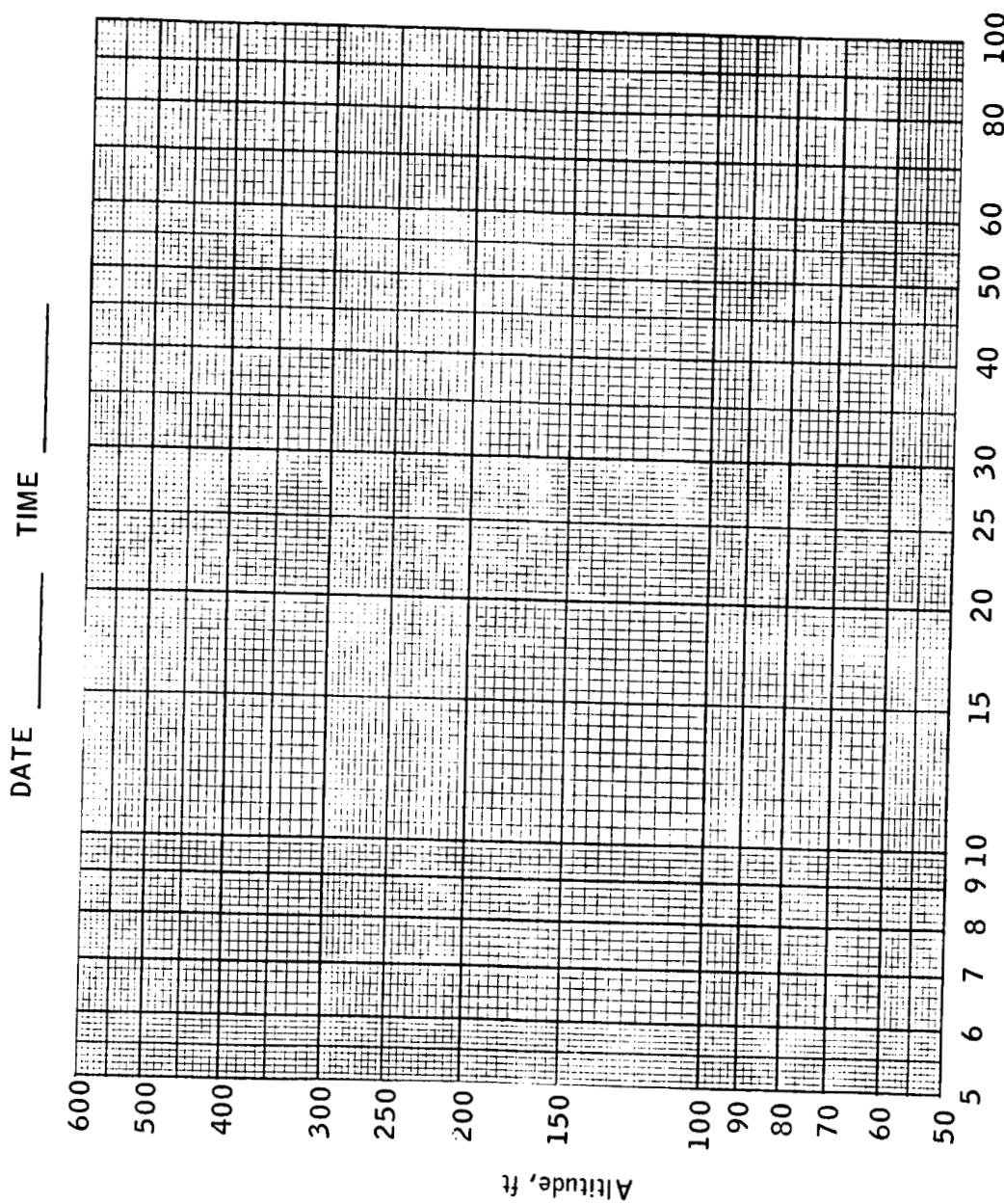


Figure 1.- Plotting chart, peak wind velocity versus altitude.

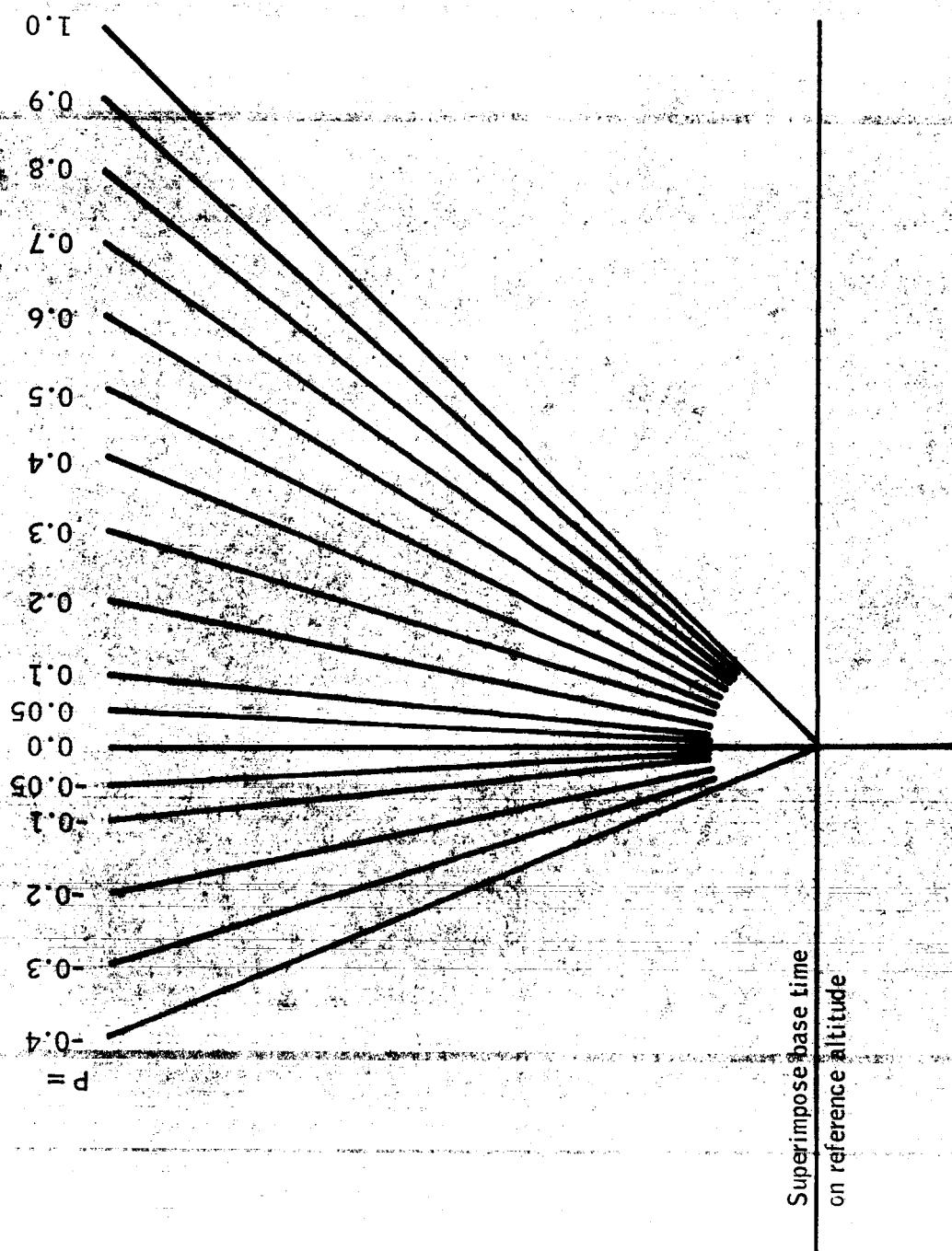
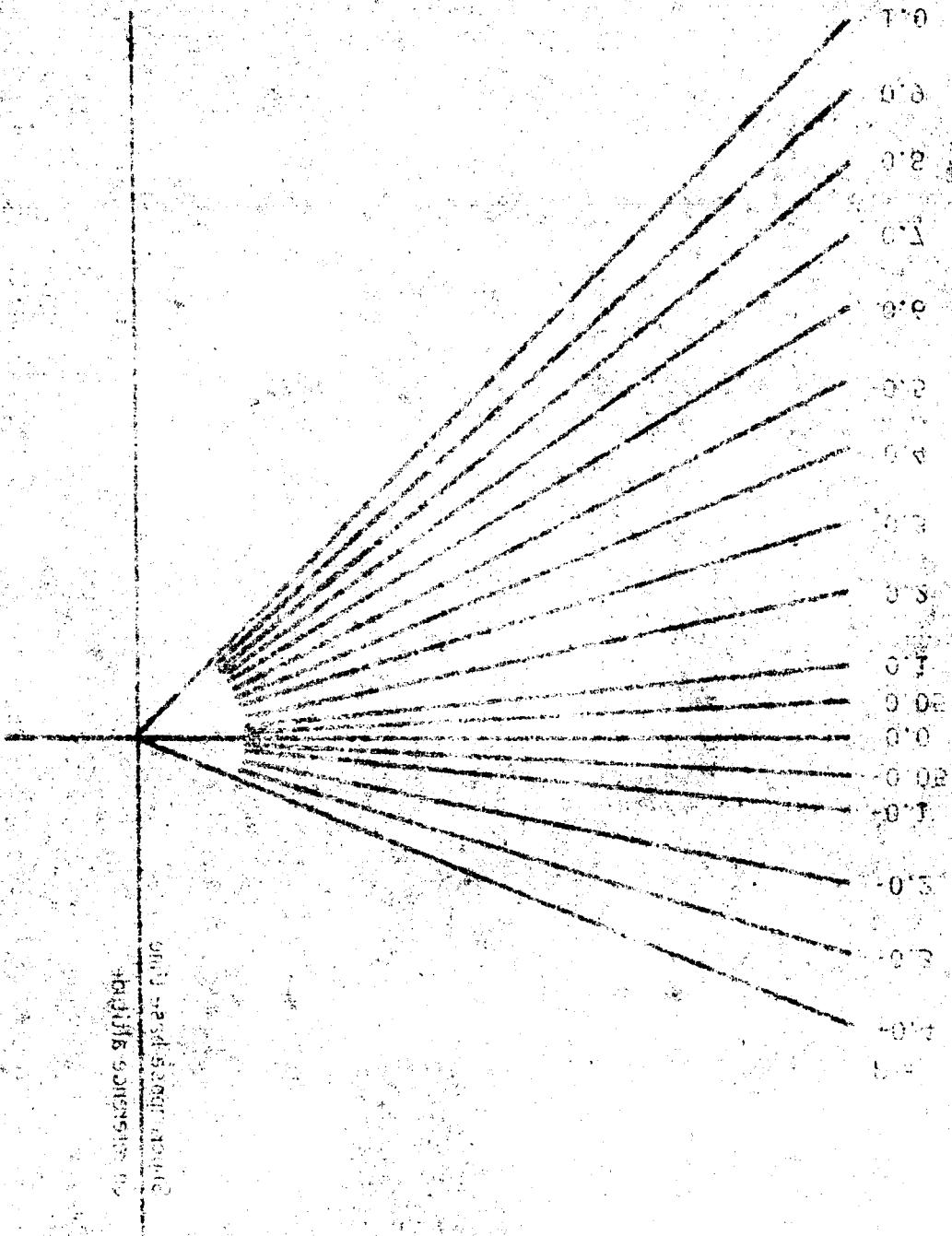


Figure 2. - Family of peak wind profile slopes.

Figure 3 - A sketch of the primary zone.



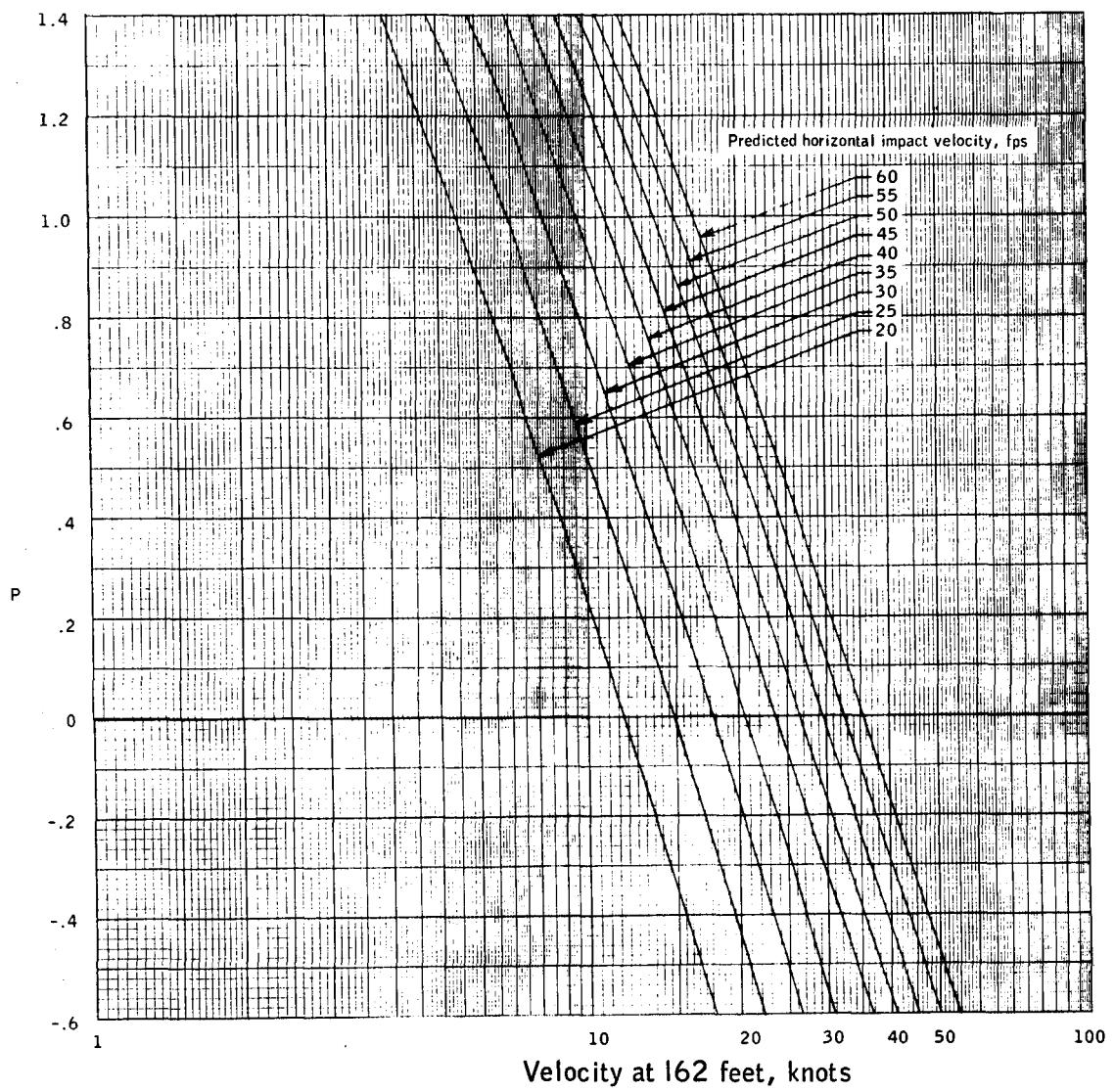


Figure 3.- Constant horizontal impact velocities plotted as functions of P versus (V_{H0}) (162-ft reference altitude, gust duration 10 seconds or more).

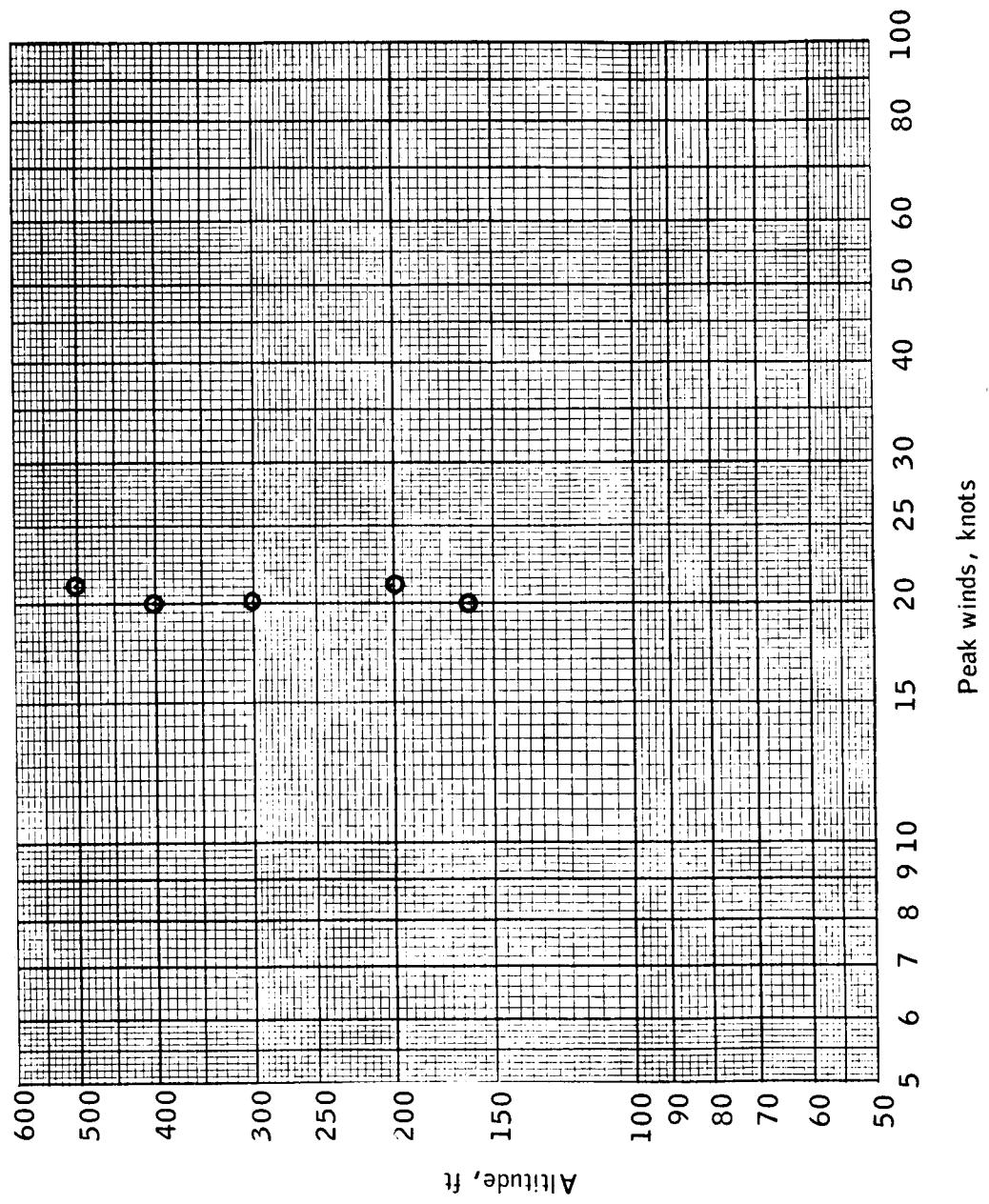
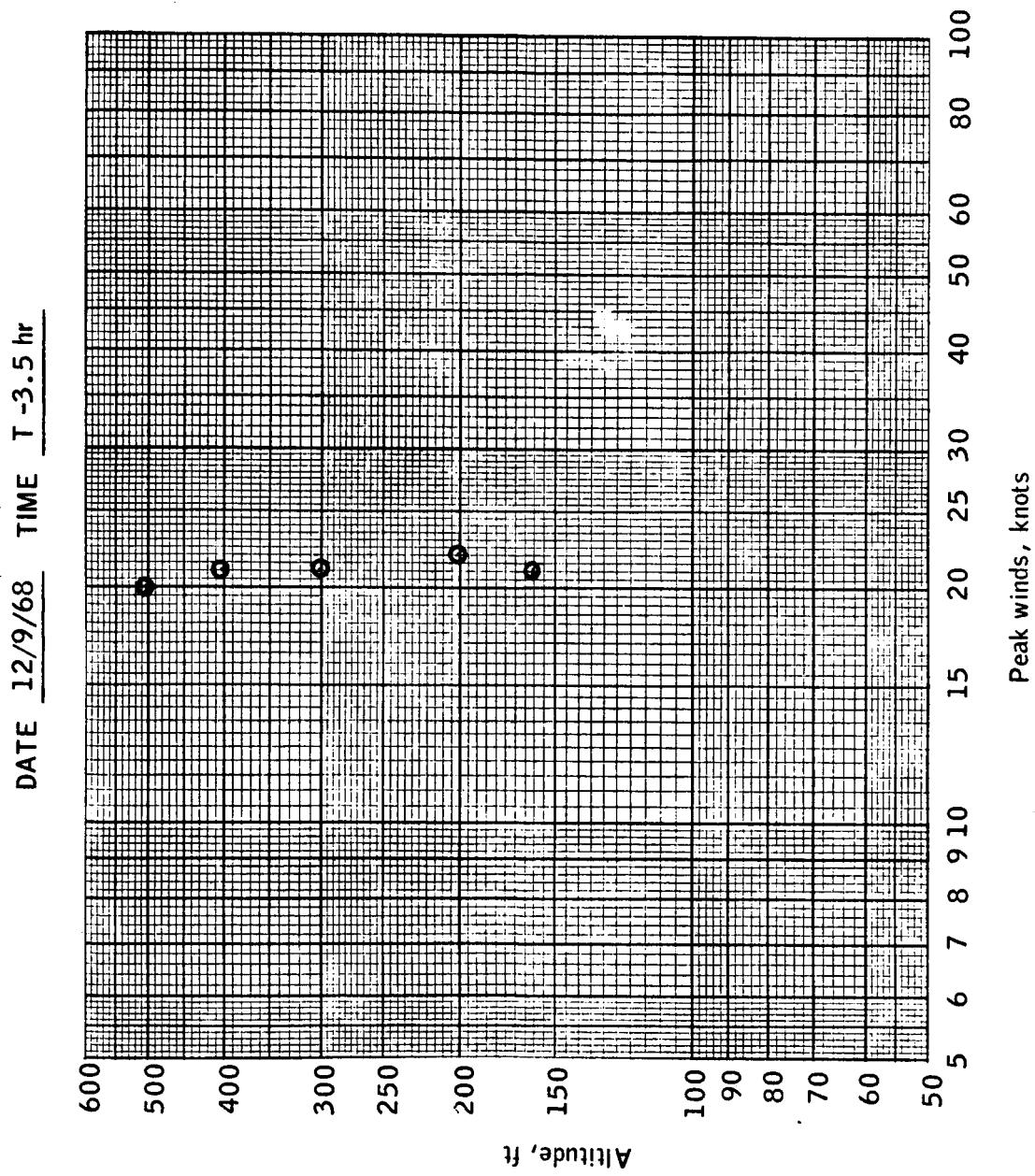


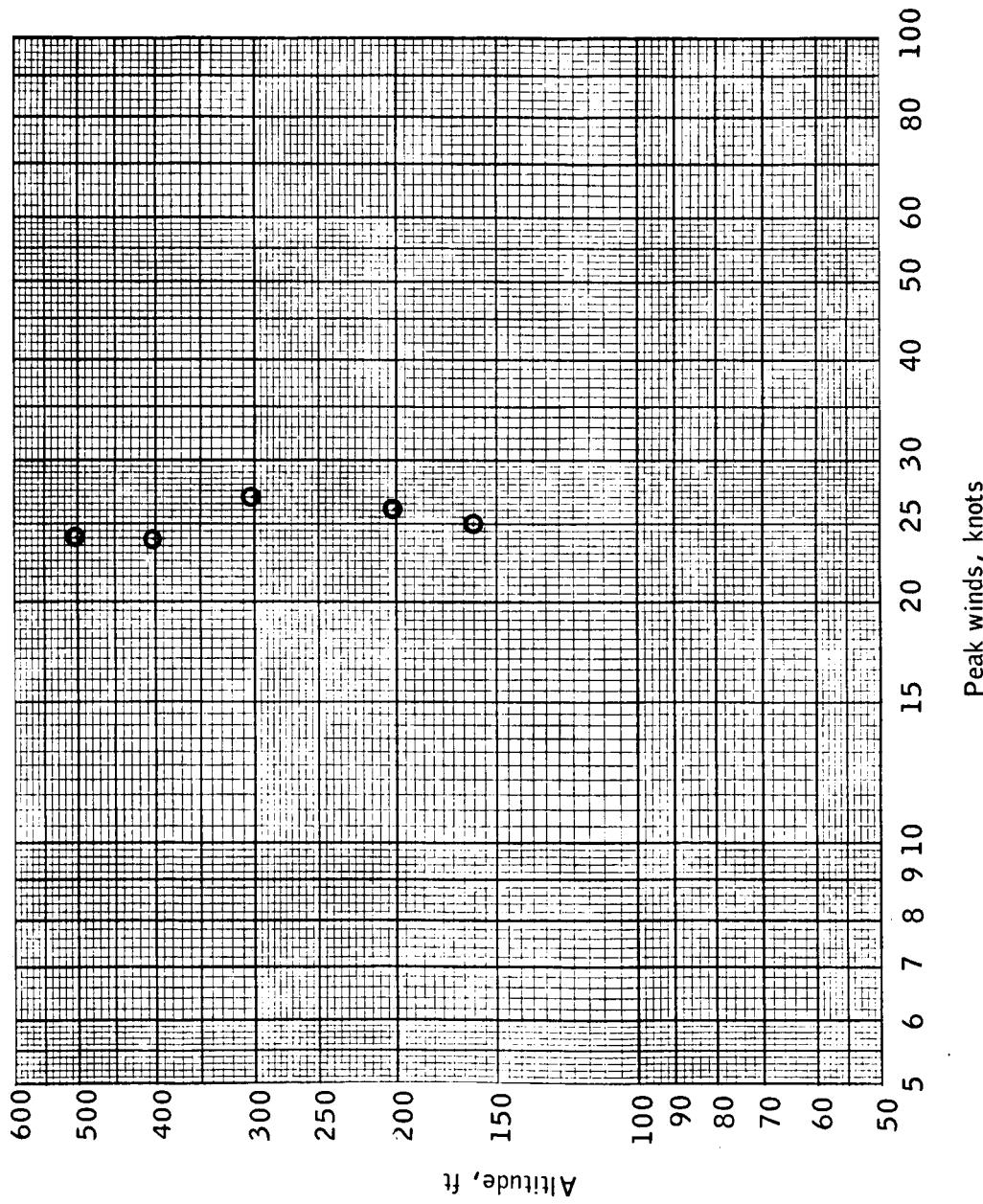
Figure 4.- Peak wind velocity versus altitude, December 9, 1968.
(a) T - 5 hours.



(b) T -3.5 hours.

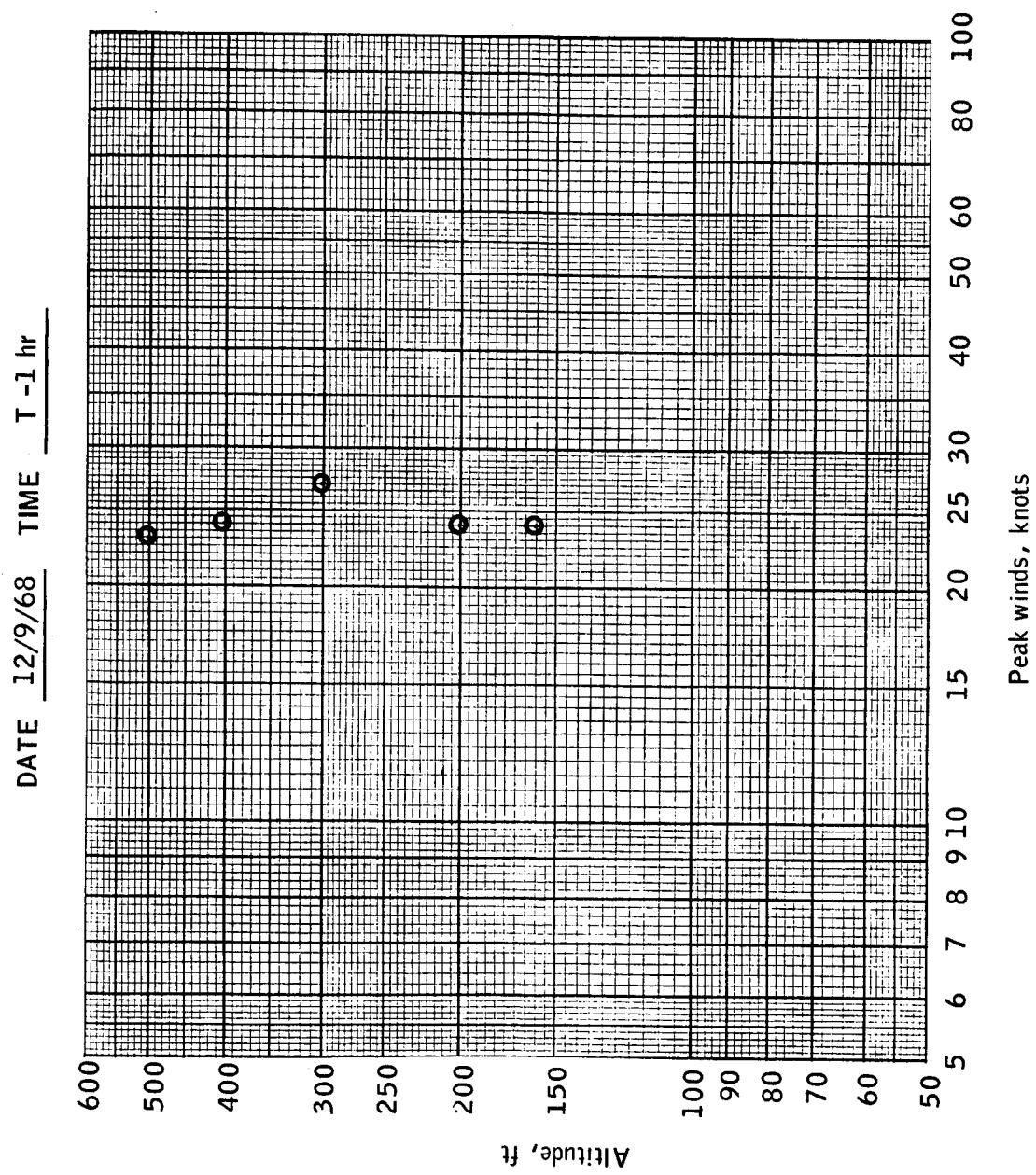
Figure 4.- Continued.

DATE 12/9/68 TIME T -2.5 hr



(c) T -2.5 hours.

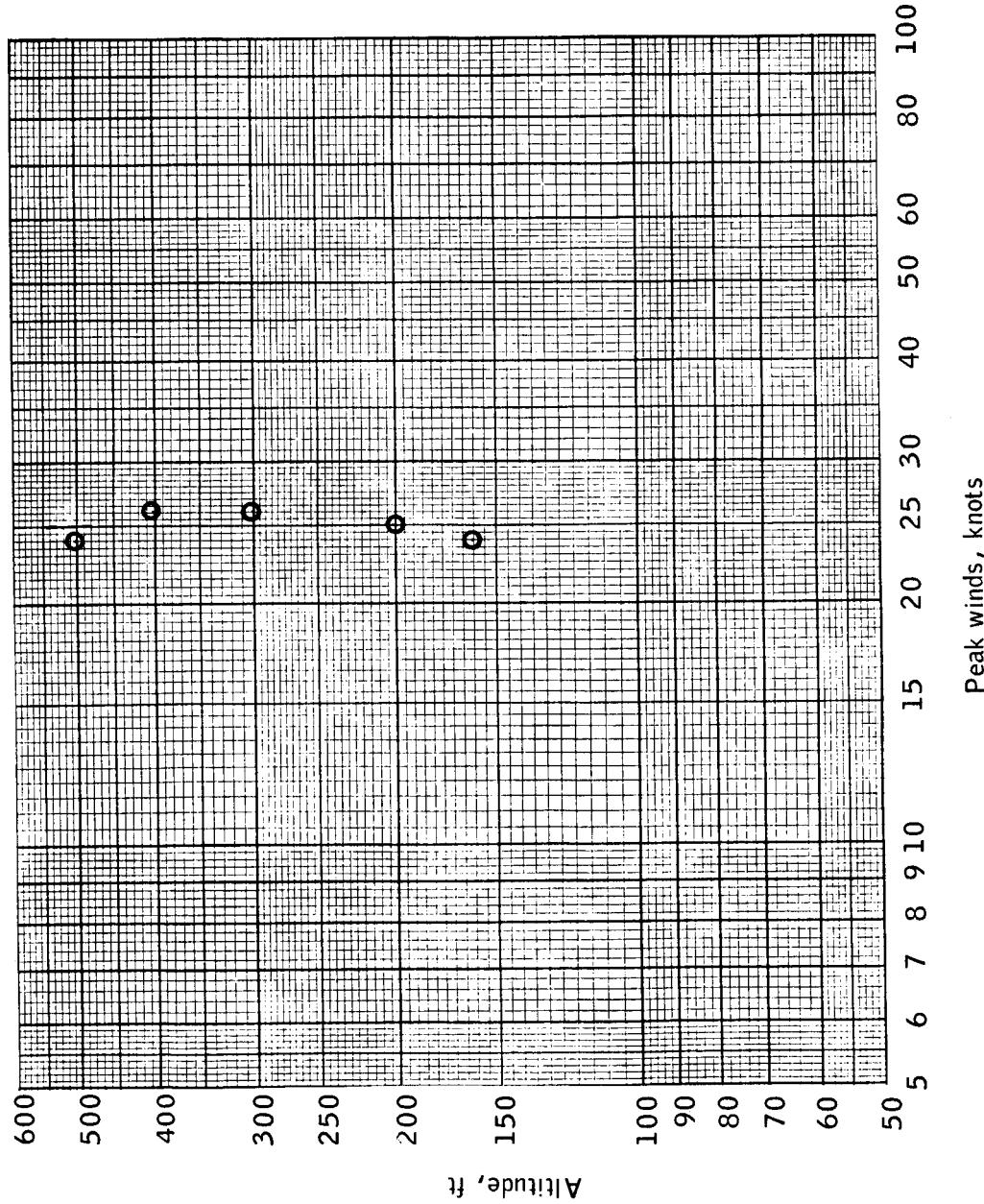
Figure 4. - Continued.



(d) T -1 hour.

Figure 4.- Continued.

DATE 12/9/68 TIME T -0.5 hr



(e) T -0.5 hour.

Figure 4.- Concluded.

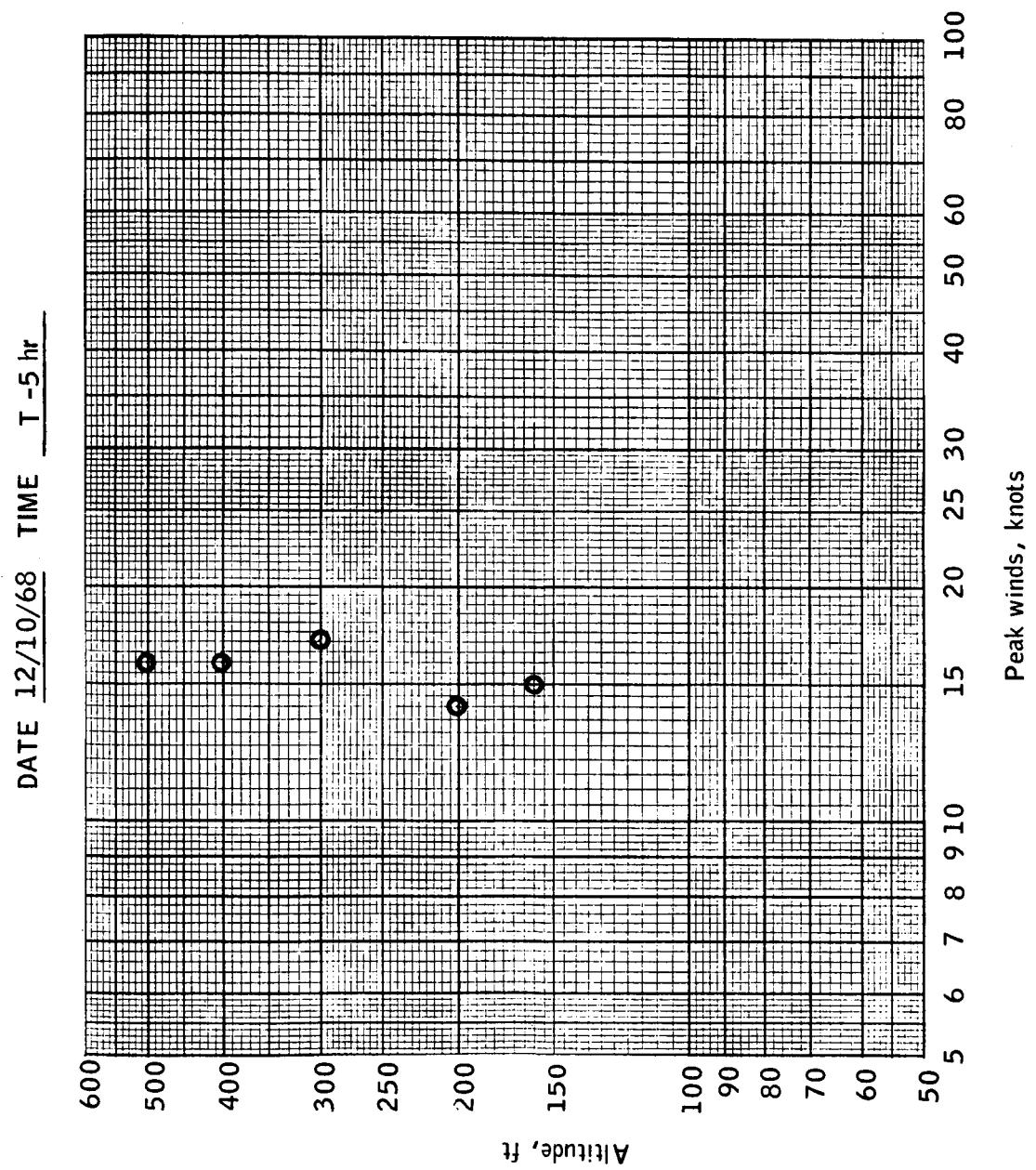
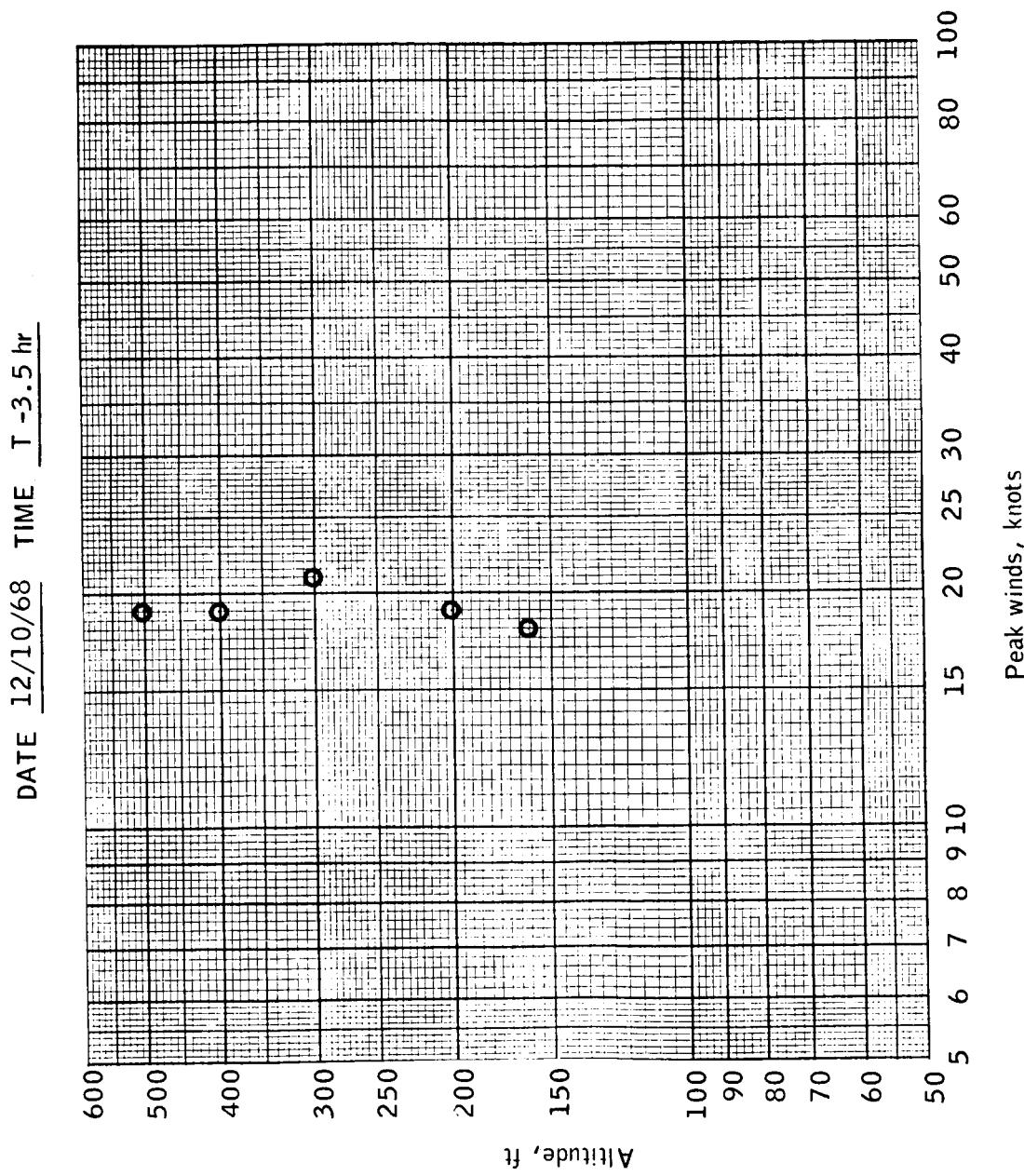
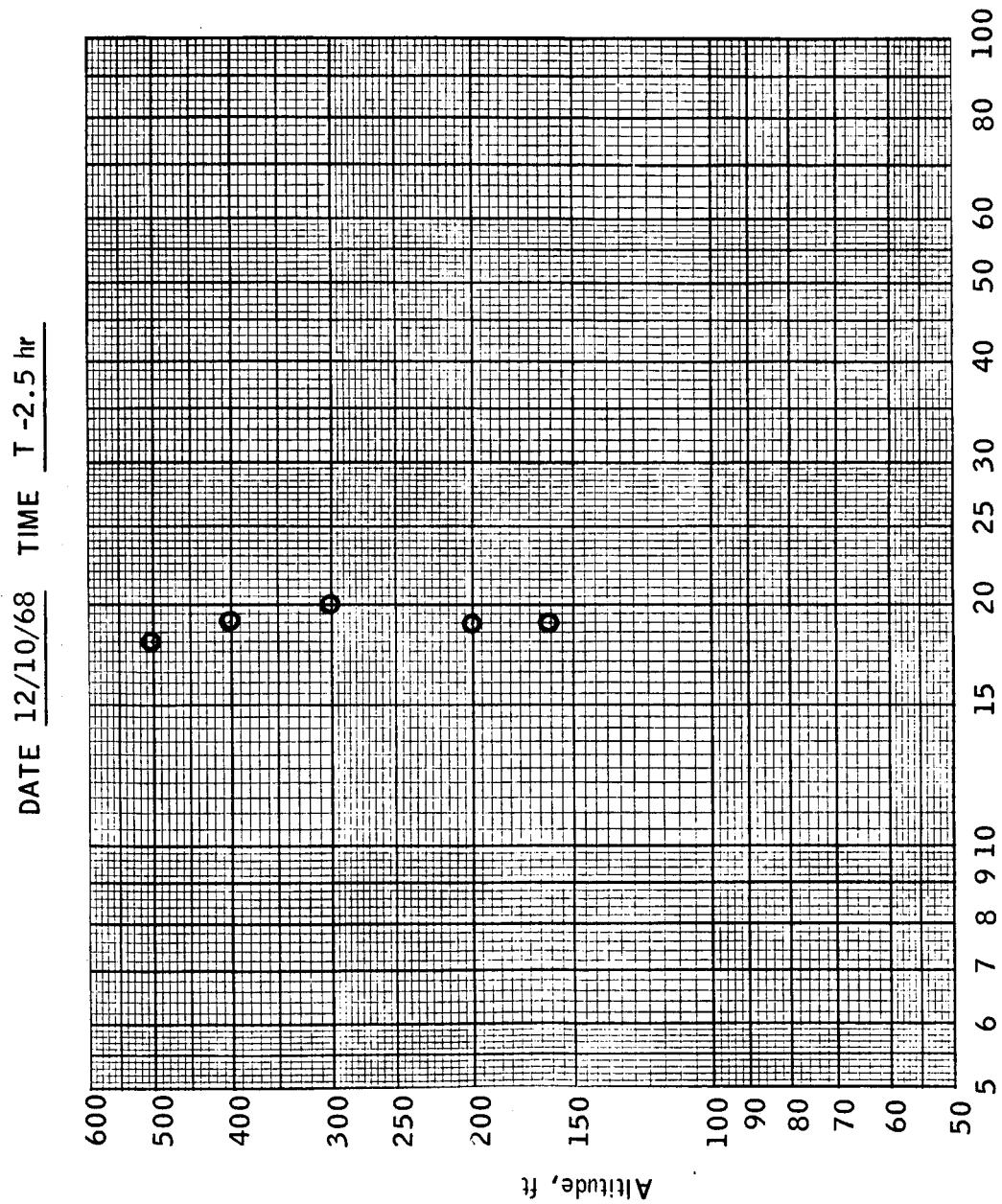


Figure 5.- Peak wind velocity versus altitude, December 10, 1968.



(b) T -3.5 hours.

Figure 5.- Continued.



(c) T -2.5 hours.

Figure 5.- Continued.

DATE 12/10/68 TIME T -1 hr

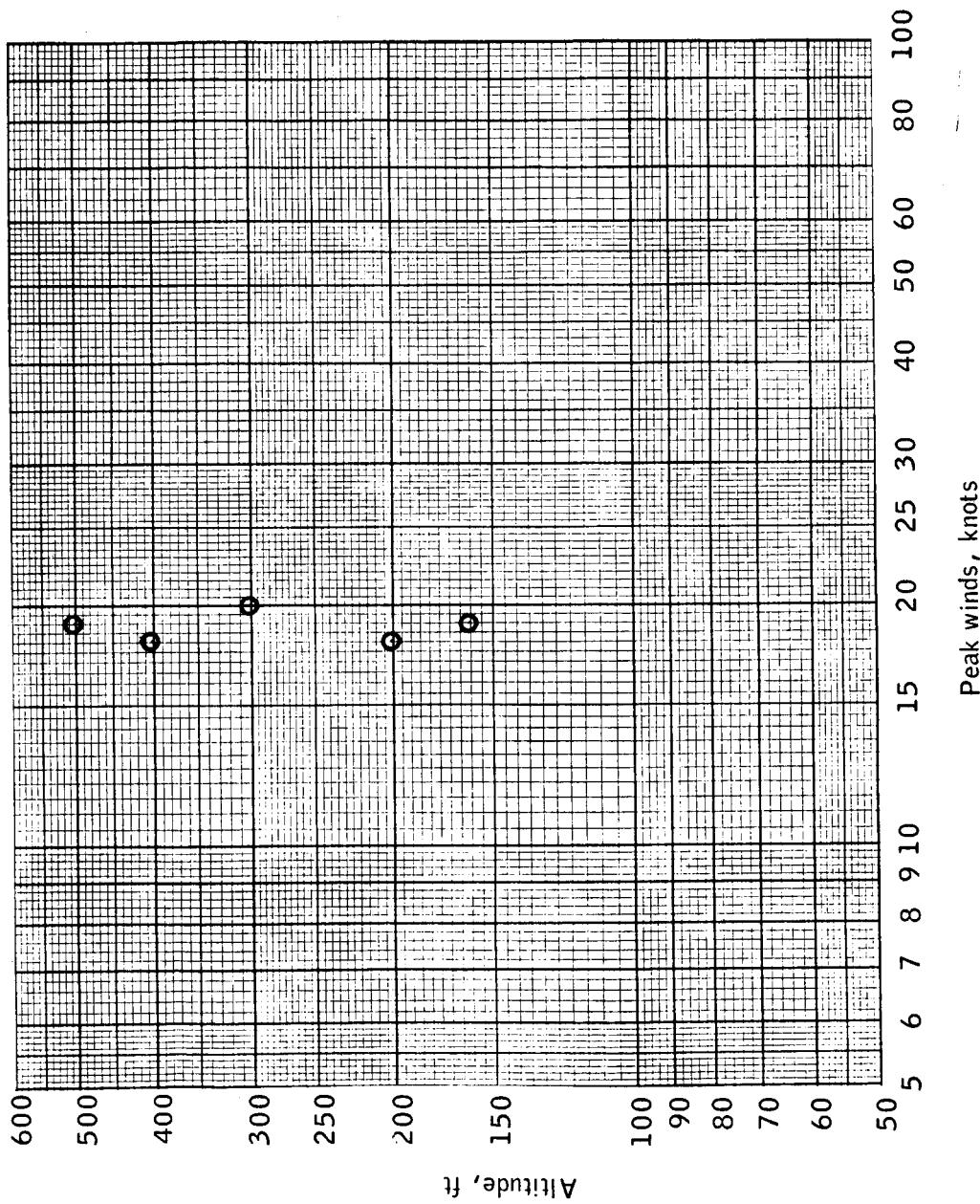
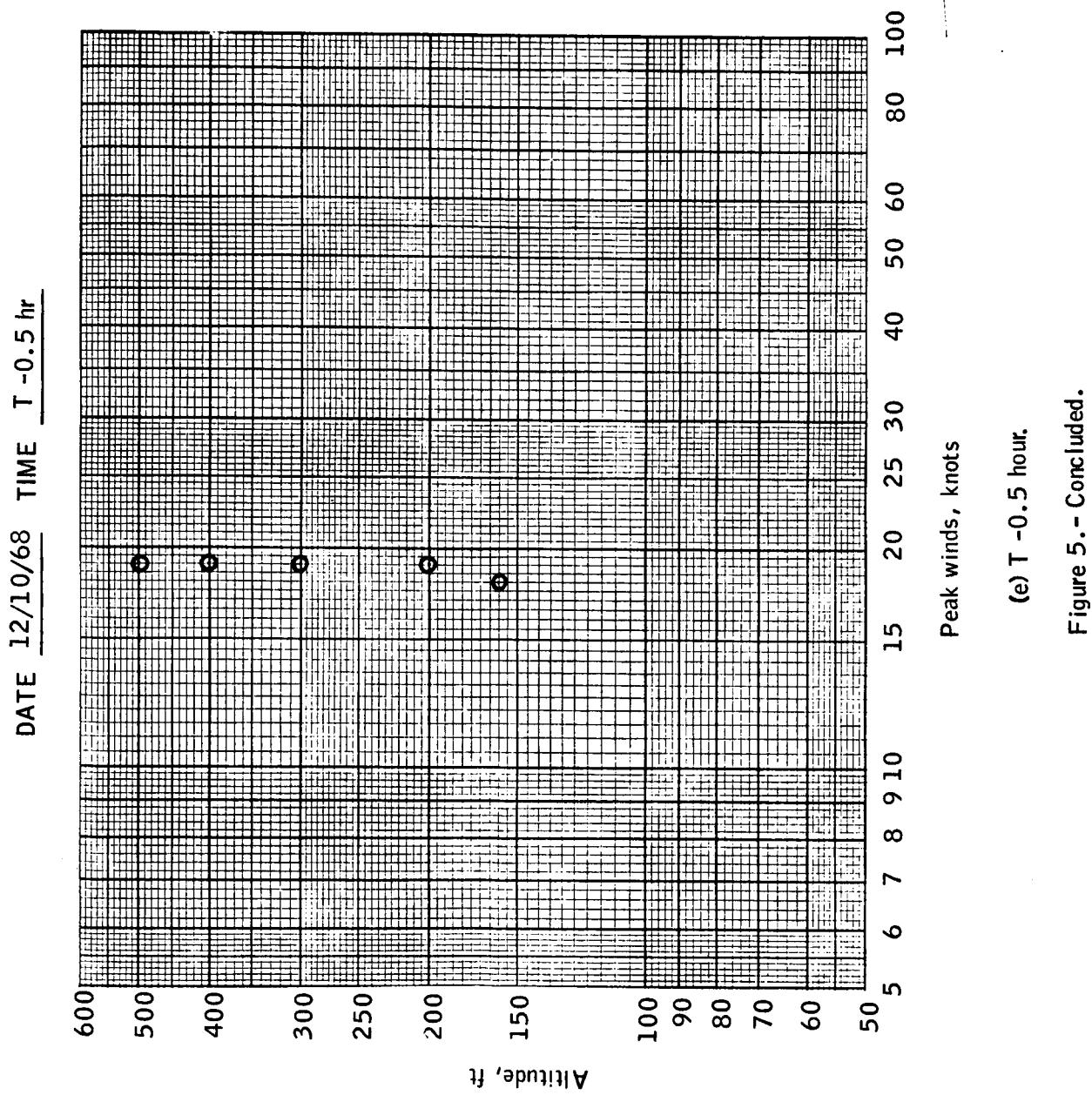
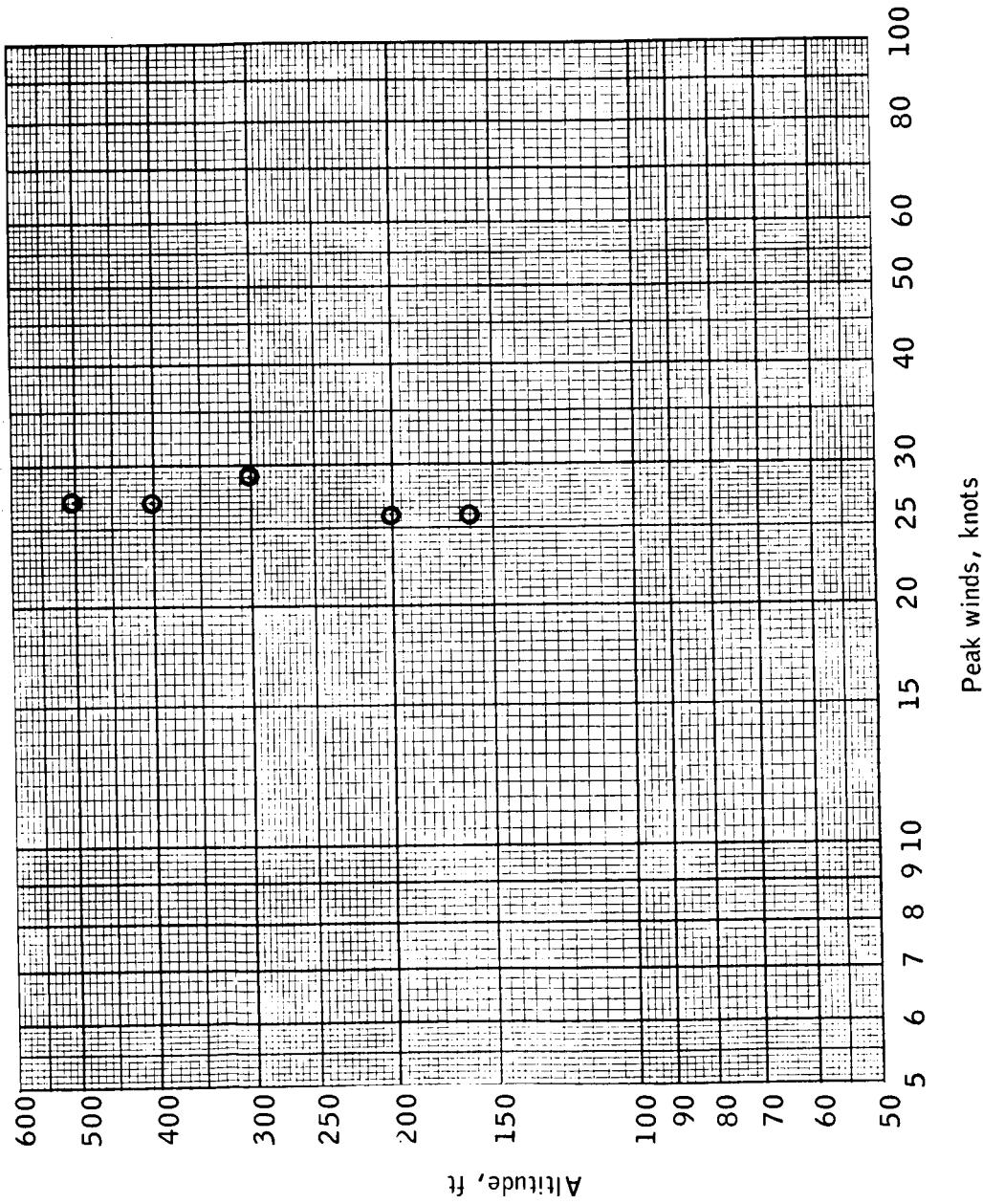


Figure 5.- Continued.
(d) T -1 hour.

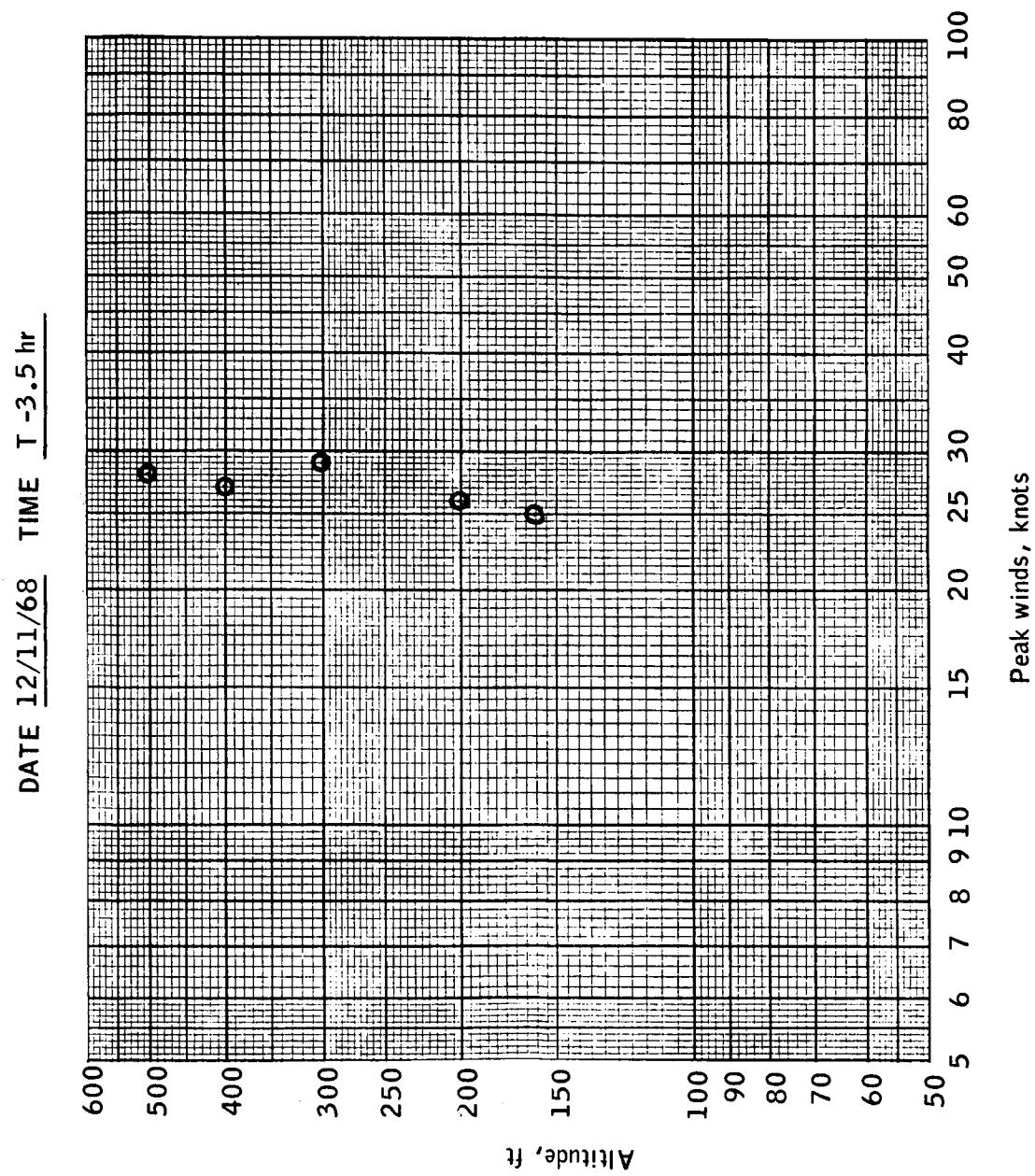


DATE 12/11/68 TIME T -5 hr



(a) $T -5$ hours.

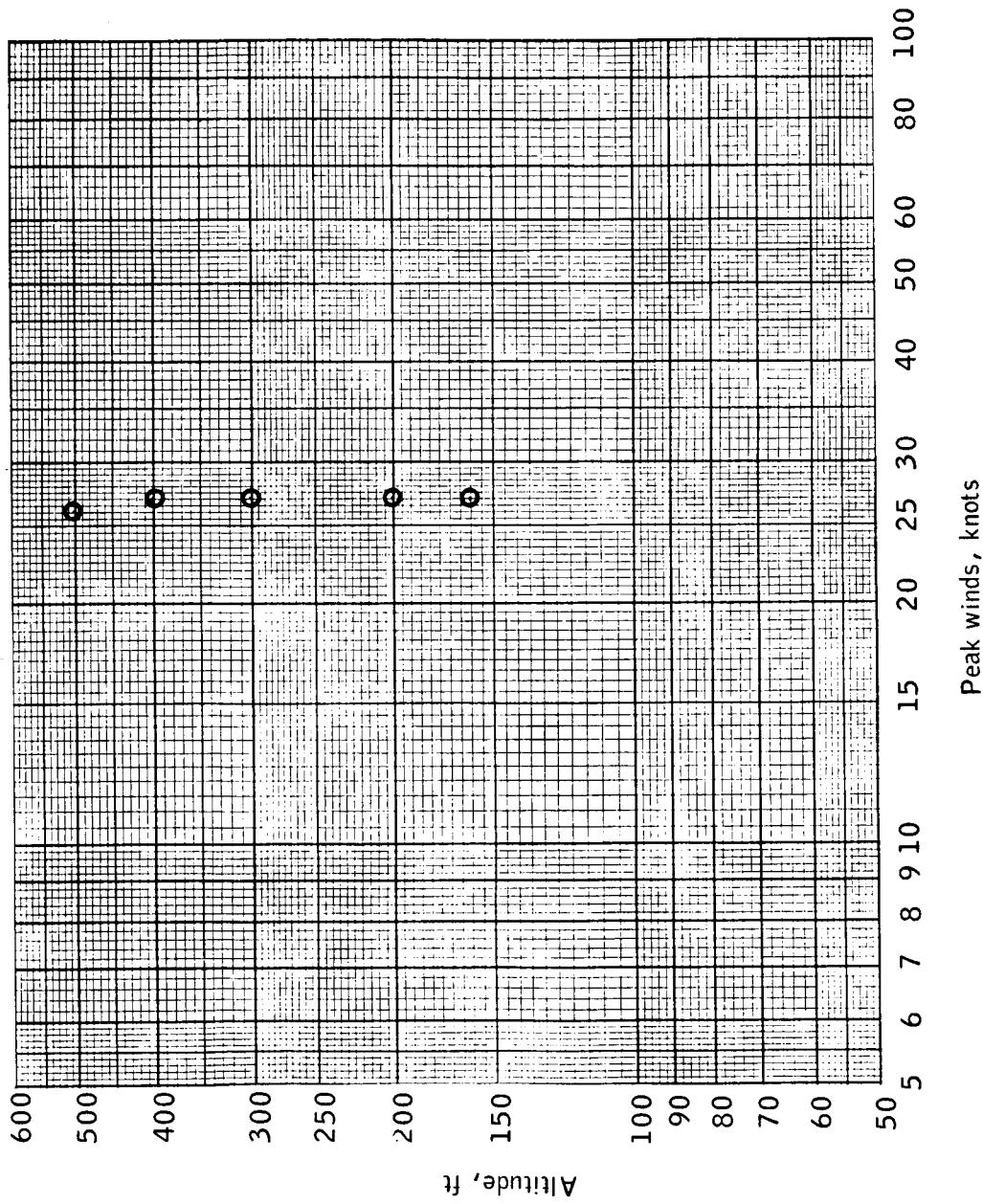
Figure 6.- Peak wind velocity versus altitude, December 11, 1968.



(b) T -3.5 hours.

Figure 6.- Continued.

DATE 12/11/68 TIME T -2.5 hr



(c) T -2.5 hours.

Figure 6.- Continued.

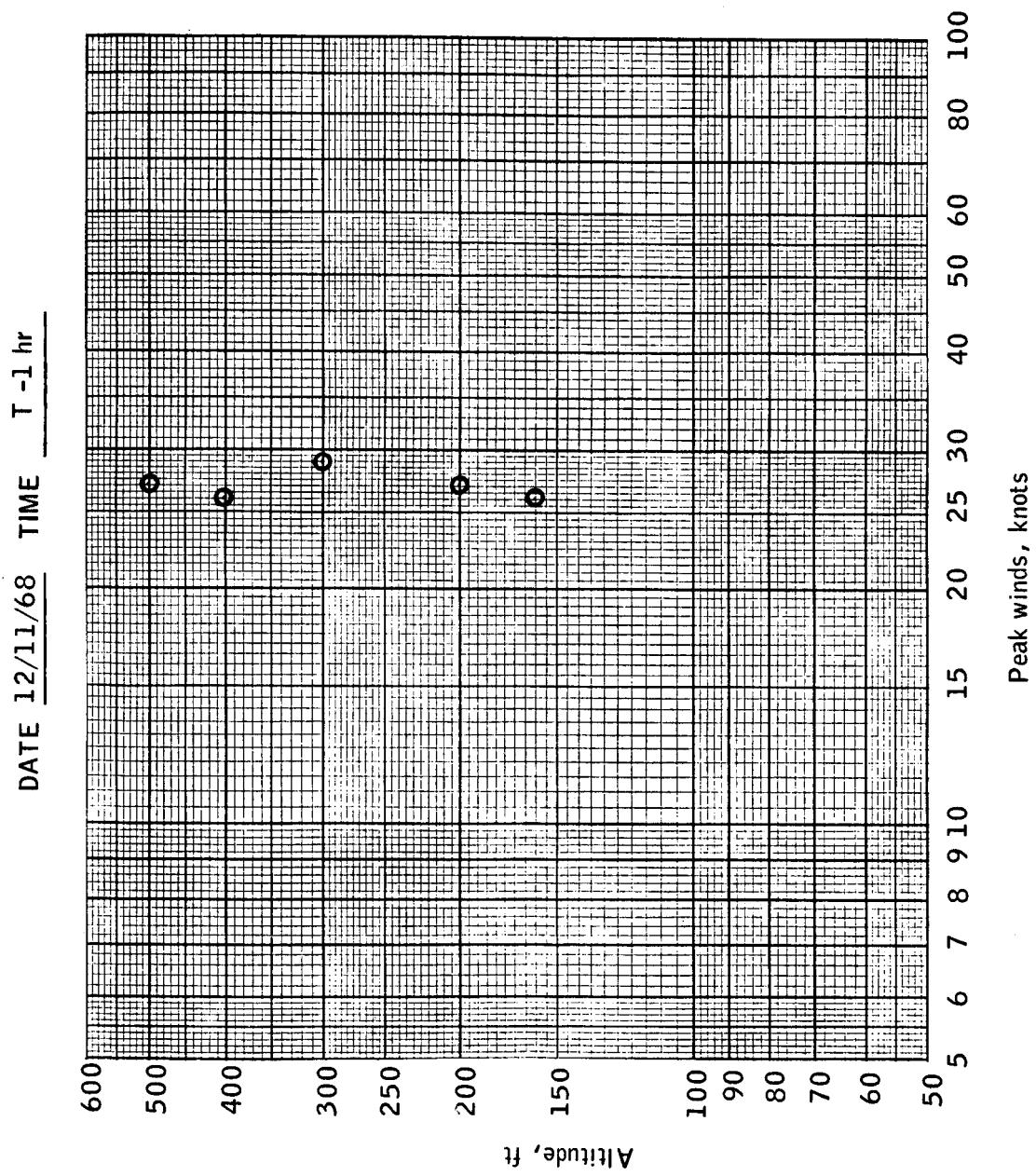
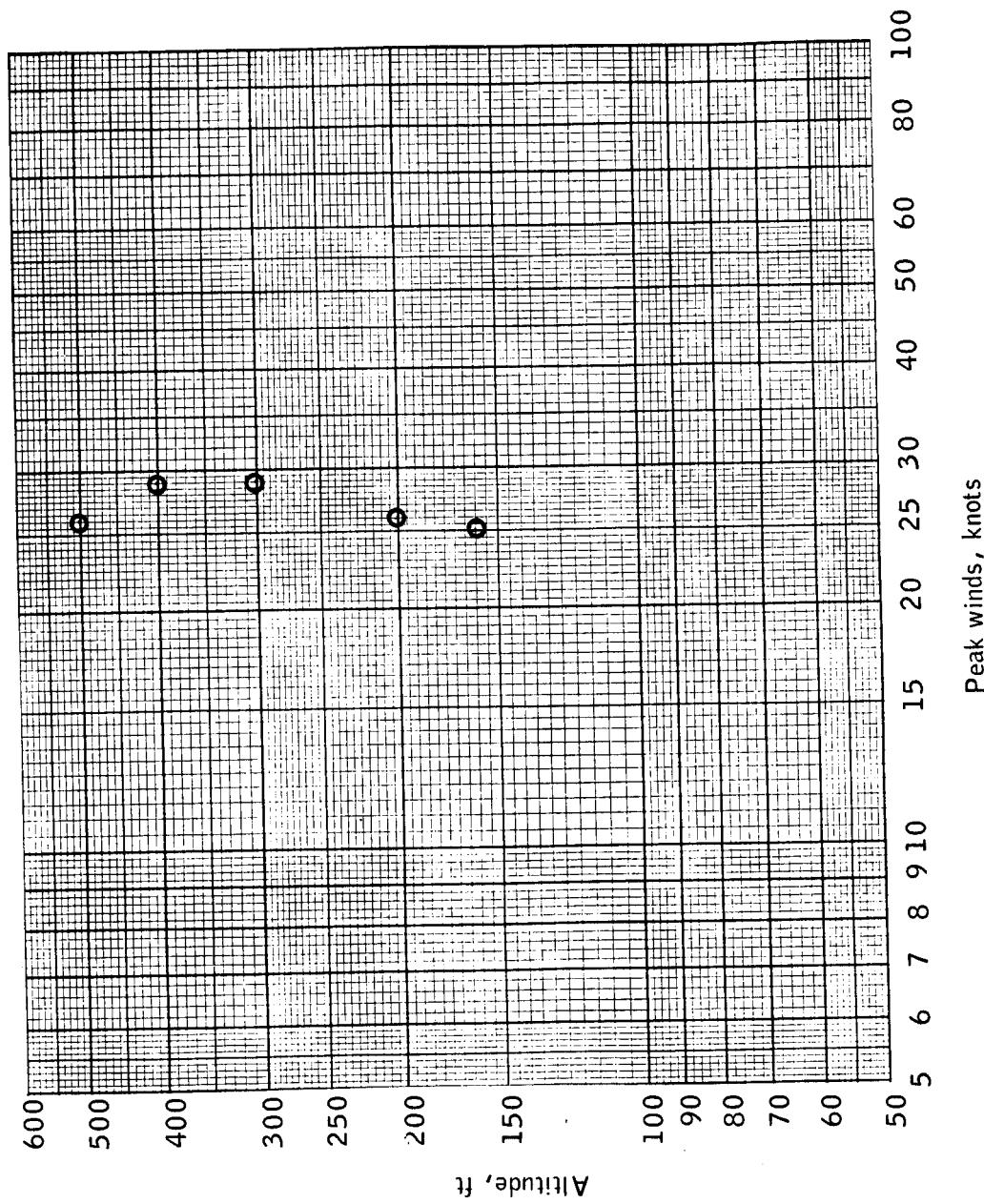


Figure 6.- Continued.

DATE 12/11/68 TIME T -0.5 hr



(e) T -0.5 hour.

Figure 6.- Concluded.

REFERENCES

1. Redd, Bass: Method for Determining Command Module Horizontal Impact Velocity. MSC memorandum ET253/6811-235-B, November 29, 1968.
2. Huss, Carl: Report on Discussions with KSC on Procedures for Predicting Horizontal Velocity for Spacecraft Land Landings. MSC memorandum 68-FM-H-100, December 2, 1968.
3. DeFife, John E.: Implementation of Procedures for Determining Prior to Launch the Command Module's Land Impact Speed, November 29, 1968.